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Etching of high-k and metal gate materials in high-density chlorine-containing plasmas KOUICHI ONO, KEISUKE NAKAMURA, KAZUSHI OSARI, TOMOHIKO KITAGAWA, KAZUO TAKAHASHI, Department of Aeronautics and Astronautics, Kyoto University, Japan, KYOTO UNIVERSITY TEAM — Plasma etching of high dielectric constant (k) films and metal electrodes is indispensable for the fabrication of high-k gate stacks. This paper presents the etching characteristics of high-k materials of HfO_2 and metals of Pt and TaN using high-density chlorine-containing plasmas, along with the plasma and surface diagnostics concerned. Attention was focused on etch chemistries and plasma conditions to achieve a high etch selectivity of $>>1$ for HfO_2 over the underlying Si and SiO_2; regarding Pt and TaN, the emphasis was placed on the etch anisotropy and selectivity of metal electrodes over the underlying HfO_2 and overlying SiO_2. The etching of HfO_2 was performed in BCl_3 without rf biasing, giving an etch rate of about 5 nm/min with a high selectivity of >10 over Si and SiO_2. At lower pressures, the deposition of BCl_x was found to occur on all the surfaces of interest; however, on HfO_2 surfaces, the deposition followed the etching during a few tens of seconds. The etching of Pt and TaN was performed with high and low rf biasing, respectively, giving a Pt etch rate of about several tens nm/min and a TaN etch rate of about 200 nm/min, with a high selectivity of >8 over HfO_2 and SiO_2 in Ar/O_2 for Pt and in Ar/Cl_2 for TaN. The etched profiles were outwardly tapered for Pt, while the TaN profiles were found to be almost anisotropic.

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